4.0 FINAL ALTERNATIVES AND EVALUATION

As noted in the previous chapter, the six action alternatives were screened based on planning constraints and considerations listed in Chapter 2 of this document. Alternatives 1, 3, and 4 were selected to be further analyzed and screened in further feasibility. These remaining alternatives were renumbered sequentially (1-3) to simplify the comparisons of alternatives for the project team and readers of this document. The final alternatives are now differentiated by the portion of dam removed where Alternative 1 provides the greatest portion of dam removal and Alternative 3 provides the least portion of dam removal.

In addition, one sub-alternative was added to feasibility-level analysis for analyzing two separate notch sizes. Separating Alternative 2 into Alternative 2A (large notch) and Alternative 2B (small notch) allowed the team to investigate whether there were different levels of project benefits and/or costs associated with increasing the size of the notch. In addition, this separation also allowed for a more thorough geotechnical comparison of the stability risks associated with dam removal. This will be discussed below in more detail.

Table 4.1 Final Array of Alternates.

Final Alternative	Description of Alternative
No-Action	No ecosystem restoration measures would be implemented.
Alternative 1: Complete Removal	Complete removal of dam and the right wall of the spillway. Complete removal of sediment. Restoration of natural channel and restoration of riverine and riparian habitat.
Alternative 2A: Large Notch	Notch Dam: Maximum notch size based on slope stability constraints and ecosystem goals. 74% removal of dam and 95% removal of sediment. Restoration of natural channel and restoration of riverine and riparian habitat.
Alternative 2B: Small Notch	Notch Dam: Minimize notch size to the minimum hydrologic passage of 23 feet due to slope stability constraints. 72% removal of dam and 95% removal of sediment. Restoration of natural channel and restoration of riverine and riparian habitat.
Alternative 3: Fish Ladder	Modify (notch/lower) dam to existing streambed level above dam and construct fish ladder to this height. 37% removal of sediment. Restoration of natural channel and restoration of riverine and riparian habitat.

All alternatives include various levels of accumulated sediment removal, dam material removal, and revegetation. The revegetation plan for all alternatives would be similar as all alternatives would require revegetation of approximately 2 acres of disturbed area. The primary difference in the revegetation plan would be that Alternative 1 and 2A are designed with a floodplain terrace while

Alternative 2B and 3 are not. Table 4.2 lists the basic differences between the project alternatives including the differences in total width of the excavated channel, as well as the amount of dam and sediment material removed for each alternatives.

Table 4.2. Details of Project Alternatives.

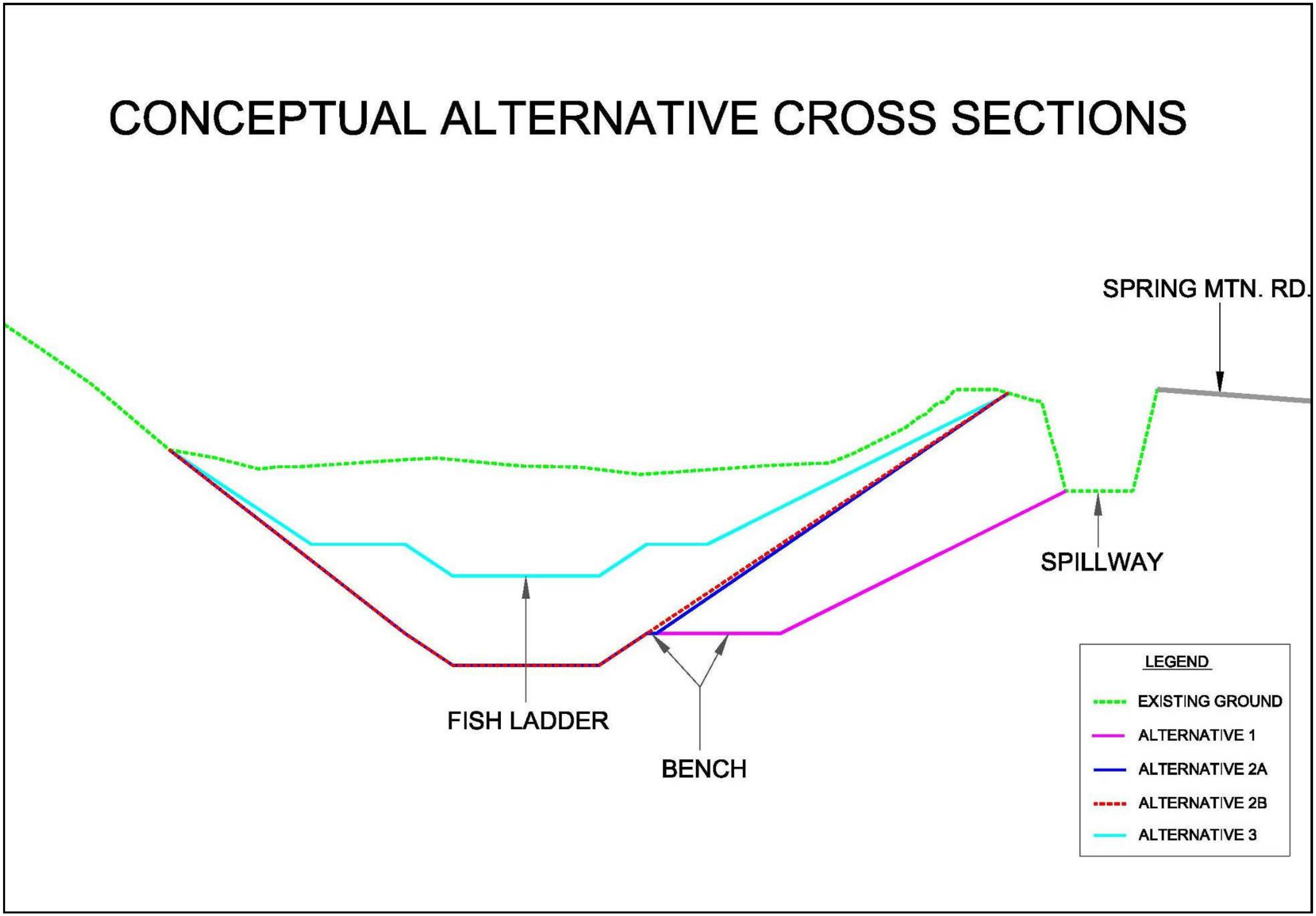
Alternative	Width of Total Excavated Channel (ft)	Constructed Stream Width (ft)	Constructed Bench Width (ft)	Dam Material			Reservoir Material	
				Dam Material Removed (Cubic yards)	Percentage of Dam Removed	Removal of Spillway	Reservoir Material Removed (Cubic Yards)	Percentage of Accumulated Reservoir Material Removed
No Action	NA	NA	NA	NA	NA	NA	NA	NA
1	53	23	30	16,284	100%	Right Wall Removed	28,100	100%
2A	32	23	1.5[1]	12,029	74%	No	26,637	95%
2B	23	23	0	11,777	72%	No	26,637	95%
3	23	23	0	8,431	52%	No	10,372	37%

Table 4.2. Details of Project Alternatives.

On the following page, in Figure 4.1 is a conceptual cross section of each alternative at it would appear through the dam.

[1] Alternative 2A was intended provide for a floodplain terrace through the dam. However, geotechnical slope stability constraints and the side slope requirement minimized the allowable floodplain terrace to only 1.5 foot.

Figure 4.1 Conceptual Cross Sections of Final Alternatives with Alternative 2A Included



4.1 NO ACTION ALTERNATIVE

The No Action Alternative assumes that no ecosystem restoration measures are implemented. There would be no action taken to modify Upper York Creek Dam from its current configuration, there would be no removal of trapped sediments from behind the dam, and no fish passage would be restored to the upper reaches of York Creek.

4.2 ALTERNATIVE 1: COMPLETE REMOVAL OF DAM AND RIGHT WALL OF SPILLWAY

4.2.1 SUMMARY OF ALTERNATIVE 1

Alternative 1 is designed to be the most complete removal of the dam. The entire earthen dam would be removed and looking upstream, the right wall of the spillway would be removed. This would provide for a total channel width of 53 feet. Because the determined width for the restored creek is 23 feet, this alternative could have up to a 30 foot bench.

In general, Alternative 1 includes the following: (1) removal of the entire earthen dam; (2) removal of all of the accumulated sediment from behind the dam; (3) construction and restoration of York Creek from just below the dam to just above the sediment basin with a slope of approximately 5%; (4) restoration of roughly 3 acres of aquatic and riparian habitat with native vegetation and; (5) use of native plants for erosion control and site stabilization.

4.2.2 DETAILED DESCRIPTION OF ALTERNATIVE 1

4.2.2.1 Removal of Dam, Spillway, and Drainpipe

Alternative 1 includes the removal of the 50-foot high and 140-foot-long earthen dam (16,284 cubic yards of material), the removal of the right wall of the 225-foot-long concrete spillway, and the removal of the 6-foot diameter steel riser pipe and trash rack.

As seen below in Table 4.3, the volume of material that would be removed has been separated into 3 reaches: Reach 1 is the material accumulated downstream of the dam; Reach 2 is the dam material; and Reach 3 is the reservoir sediment located behind the dam.

Two primary disposal sites have been identified for this project. The first site is the City's Lower Reservoir. The second location is Clover Flats, a permitted landfill that is located within 10 miles of the project site. For detailed disposal inforation, please refer to Chapter 4, section 4.2.1.1 Accumulated Sediment Disposal and Reuse

Table 4.3. Alternative 1: Quantity of Dam and Sediment Removal.

Alternative 1: Estimated Dam and Sediment Removal Quantity in cubic yards (yd^3)	
Reach 1: Downstream Sediment	1,025
Reach 2: Dam Material	16,284
Reach 3: Reservoir Sediment	28,100
Total	45,409

4.2.2.2 Accumulated Sediment Removal

As seen in Table 4.3, the estimated amount of accumulated sediment to be removed from behind the dam is 28,100 cubic yards. Before the dam and sediment material is hauled off, it would be sorted, and materials necessary for restoration would be stockpiled. It is estimated that approximately 400 cubic yards of dam material is needed to recontour the channel.

As mentioned in the previous section, two primary disposal sites have been identified. They include the Lower Reservoir and Clover Flat. For detailed disposal inforation, please refer to Chapter 4, section 4.2.1.1 Accumulated Sediment Disposal and Reuse

4.2.2.3 Channel Restoration

The primary difference between the alternatives is that Alternatives 1, 2A, and 2B would be constructed as close as possible to flow through the historical channel whereas Alternative 3 would be constructed from the top of the fish ladder (over dam) and through the remaining sediment basin. Specifically, the Alternative 3 channel would be constructed 10-12 feet above the original channel bed.

Floodplain Terraces
Based on modeling results and representative stream reaches and cross-sections from upstream of the project area, the suggested constructed creek width is cross section 23 feet wide and 5 feet deep with a floodplain terrace measuring from 2 to 50 feet, depending on the location in the project site. Larger benches are possible in the center of the reservoir area.

Meander Design
In order to determine how the restored channel will flow through the project site, an approximate meander wavelength from the representative reach area was used. The representative reach used is immediately upstream of the proposed restoration area and has a similar slope.

Channel Bottom Material
The existing channel bottom material in the representative stream reach consists mostly of boulders and cobbles for the entire width of the stream. It is suggested that the excavated stream channel be lined throughout its entirety with cobbles and boulders of similar gradation to that which is found in the representative stream reach.

Excavation and Cut Slopes
The excavation angle into the floodplain terrace and hillsides above the channels would ideally have been 2H:1V for long term stability, but since the natural hillside slope angles (west slopes) are as steep as 1H:1V in places, steeper cuts may be necessary.

Channel Restoration Design
Two specific channel restoration designs have been developed from these dimensions and parameters mentioned above.

The first channel design (Channel Design 1) would be designed to include all features of a functioning creek. The design will include channel cross-sections, plan form, pools and riffles, channel slope and bottom material. For detailed information on Creek Design One, please refer to plates 3 -6 of Appendix A: Hydrology and Hydraulics and to Sheets 2, 3-1 through 3-10, 4, 5, 6, and 7 of Appendix B: Civil Design Engineering

The second channel design (Channel Design 2) would be limited to a basic cross-section, plan, slope, and bottom material. Pool and riffles would be allowed to form naturally over time within this cross-section. The basic cross-section will be similar to the riffle detail on Plate 7 of Appendix A: Hydrology and Hydraulics.

Table 4.4. Creek Restoration Features

Channel Design	Features	Comments
1	channel cross-sections, plan form, pools and riffles, channel slope and bottom material	An attempt to restore the channel to its pre-dam configuration.
2	channel cross-section, plan form, channel slope and bottom material	Provides a simple cross-section*, plan and original slope. Pools, riffles, and bars will form over time. Recommended design.

* Similar to the riffle detail on Plate 7 of Appendix A: Hydrology and Hydraulics

Currently, the channel is designed as described above for Channel Design One. However, further geomorphic analysis has shown that Channel Design Two would provide the recommended restoration cross-sections, plan and slope requirements and that pools, riffles and bars would naturally form over time. It is likely that this method would be more cost effective and therefore will be further considered during the Plans and Specifications Phase.

For Channel Design 1, channel restoration includes design features of pools, riffles, and runs in the channel design. Specifically, there are 4 pools, 5 riffles, and 1 run included in initial design. The riffles are designed to be approximately 64 feet long, the pools 105 feet long, and the run to be between 69 and 92 feet long. These features are preliminary. Pool and riffle lengths for this design are purposely longer than representative reaches in York Creek. There is adequate existing sediment in the upper watershed that is expected to move downstream and into the project area. This sediment load would allow the engineered creek to adapt to its own equilibrium over time. Pools and riffles are expected to shorten until an equilibrium state is reached.

4.2.2.4 Revegetation

In general, the Habitat Revegetation Design provides a single methodology for revegetation that is applied to all of the project alternatives. The project would require revegetation of roughly 2 acres of disturbed area for all alternatives. Revegetation would focus on creation of self-sustaining native vegetative habitat, control of erosion and stabilization of the newly created stream channel.

Revegetation of the areas disturbed by construction would follow three vegetation types: Bank Zone, Terrace Zone, and Riparian Zone. These zones were based preliminary on hydraulic modeling to establish the elevations of the zones relative to the channel bed. These zones would be refined on the basis of further iterations of the detailed design of the recommend alternative.

Specifically, Alternative 1 would have 0.4 acres of Bank Zone, 0.6 acres of Terrace Zone and 1.2 acres of Riparian Zone. This would total 2.2 acres of habitat acreage.

The Bank Zone would be planted with emergent aquatic vegetation 0.5 to 3 feet above low flow water surface elevations. There would be 2 to 5 rows of plants, spaced 1 foot apart. Plants such as rush, sedge, wildrye, deergrass, willow and alder would be used. The Terrace Zone would be planted with woody plants placed 3 to 5 feet above the low flow water surface. Plants such as wildrye, deergrass, maple, elder, dogwood, buckeyes, oak and fir, amongst others, would be used. The Riparian Zone would be planted with trees and shrubs placed approximately 5 feet above low flow water surface elevation. Plants such as dogwood, redwood, firs, snowberry, oaks, rose and buckeyes, amongst others, would be used.

4.3 ALTERATIVE 2A: LARGE NOTCH

Alternative 2A was intended to remove the majority of the dam to provide for a floodplain terrace through the dam. The total channel width would be 32 foot and it was believed that this would allow for a 9-foot floodplain terrace. However, geotechnical slope stability constraints and the 1:5:1 side slope requirement minimized the allowable floodplain terrace to only 1.5 foot. Additionally, vegetated riprap would be necessary to protect the embankment from erosion and the vegetated riprap would completely bury the 1.5 bench.

Due to the constraints mentioned above, Alternatives 2A and 2B became almost identical in design. Additionally, as will be shown in section 4.8 Alternative Benefits and section 4.9 Alternative Costs, .Alternative 2A is expected to more costly while providing the same level of ecological outputs as Alternative 2B.

Due to the above, Alternative 2A has been dropped for further analysis. Sections 4.8 and 4.9 will include costs and benefits for Alternative 2A.

4.4 ALTERATIVE 2B: SMALL NOTCH

4.4.1 SUMMARY OF ALTERNATIVE 2B

Conceptually, Alternative 2B was designed to provide aquatic passage for the 1% storm event and to remove the least amount of the dam based on the early assumption that this could provide for higher levels of slope stability with the fewest geotechnical measures in place. Alternative 2B would provide for a total channel width of 23 feet. Because the determined width for the restored creek is 23 feet, this alternative does not allow for a floodplain bench.

In general, Alternative 2B includes the following: (1) removal of approximately 72% of the earthen dam structure; (2) backfilling the spillway with dam material for stabilization; (3) removal of approximately 95% of the accumulated sediment from behind the dam; (4) construction and restoration of York Creek from just below the dam to just above the sediment basin with a slope of approximately 5%; (5) restoration of roughly 3 acres of aquatic and riparian habitat with native vegetation and; (6) use of native plants for erosion control and site stabilization.

Alternative 2B is the geotechnically favored alternative as this alternative appears to be the most stable of all alternatives.

4.4.2 DETAILED DESCRIPTION OF ALTERNATIVE 2B

4.4.2.1 Removal of Dam and Drainpipe; Filling of Spillway

Alternative 2B provides for the minimal hydrologic passageway to handle 1% storm event in order to maximize the slope stability.

Alternative 2B includes the removal of approximately 72% percent of the earthen dam (11,777 cubic yards of material), the removal of the 6-foot diameter steel riser pipe and trash rack, and the spillway being filled with dam material.

Table 4.5. Alternative 2B: Quantity of Dam and Sediment Removal.

Alternative 2B: Estimated Dam and Sediment Removal Quantity in cubic yards	
Reach 1: Downstream Sediment	830
Reach 2: Dam Material	11,777
Reach 3: Reservoir Sediment	26,637
Total	39,244

4.4.2.2 Accumulated Sediment Removal

As seen in Table 4.5, it is estimated that 26,637 cubic yards of sediment will need to be removed for this alternative.

4.4.2.3 York Creek Channel Restoration:

The channel restoration design for this alternative is similar to the description for Alternative 1.

4.4.2.4 Revegetation

The revegetation plan for Alternative 2B is similar to the description for Alternative 1. The primary difference in the revegetation plan for Alternative 1 is that it allows for a floodplain terrace that would be planted with native vegetation while Alternative 2B does not allow for a terrace. Specifically, Alternative 2B would have 0.4 acres of Bank Zone, 0.5 acres of Terrace Zone and 1.1 acres of Riparian Zone. This totals 2.0 acres of restored habitat acreage.

4.5 ALTERNATIVE 3: FISH LADDER

4.5.1 SUMMARY OF ALTERNATIVE 3

Alternative 3 is designed to notch the dam as necessary to construct a concrete fish ladder through the notch and over the dam. The suggested fish ladder is a step-pool/weir design through the existing dam site.

In general, Alternative 3 includes the following: (1) notching the dam as necessary to construct a concrete fish ladder through the notch and over the dam; (2) removal of approximately 52% of the earthen dam structure; (3) backfilling the spillway with dam material for stabilization; (4) removal of approximately 37% of the accumulated sediment from behind the dam; (5) construction and restoration of York Creek from above the dam and fish latter upstream through the lowered sediment basin; (6) restoration of roughly 3 acres of aquatic and riparian habitat with native vegetation and; (7) use of native plants for erosion control and site stabilization.

4.5.2 DETAILED DESCRIPTION OF ALTERNATIVE 3

4.5.2.1 Notching of Dam; Removal of Drainpipe; Filling of Spillway

This alternative was developed as a method to reduce the extent of dam removal. Alternatives 1 and 2B require partial or complete of the dam to the elevation of the original streambed. Under this alternative dam removal would be less extensive. A section of the dam would be lowered approximately 20 feet. A fish ladder would then be constructed on the remaining face of the dam and would tie in to the creek upstream of the dam site.

The advantage of this alternative is that it reduces the volume of material to be removed and there is less concern of dam slope stability. The main disadvantage of this alternative is that fish ladders for this application are less reliable for fish passage and require more maintenance than a creek at its natural stream bed elevation. This will be discussed in detail below.

Specifically, Alternative 3 includes the lowering of the dam by removing approximately 52% of the earthen dam (8,831 cubic yards of material), the removal of the 6-foot diameter steel riser pipe and trash rack, and filling the spillway with dam material that would be removed to form the notch.

Table 4.6: Alternative 3: Quantity of Dam and Sediment Removal.

Alternative 3: Estimated Dam and Sediment Removal Quantity in cubic yards	
Reach 1: Downstream Sediment	969
Reach 2: Dam Material	8,431
Reach 3: Reservoir Sediment	10,372
Total	19,772

4.5.2.2 Design of Fish Ladder

The suggested fish ladder for this project site is a step-pool/weir design through the existing dam site. This type of ladder was chosen after reviewing all types and different configurations of fish ladder designs presented in several publications produced by various state agencies. This ladder would be made entirely of concrete to avoid sediment contributions from the sides of the dam. The only source of sediment is expected to come from upstream sources. A Denil-type ladder was not considered due to the high slope on which it would have to be constructed and the possible cost associated with such a structure. The dimensions for the ladder are as follows.

The width of each step in the fish ladder structure is 23 feet, which is also the width of the upstream portion of the creek. The actual width of the box in each step is 4 feet. It is 5 feet long and 20 inches high. The corners in the back of the box should be rounded so that a dead zone of inactivity is not established in each pool. The opening of the box is 1.5 feet wide and has a notch that extends down18 inches. The expected jump height between each box, with water, is 12 inches or less.

Construction of this fish ladder would use cast-in-place reinforced concrete to form the steps. First, footing for the concrete would be constructed, after which wall forms would be assembled using aluminum or wood. Once this is done, steel rebar would be installed to serve as reinforcement for the concrete. With the wall forms and reinforcement in place, concrete would be placed into all wall forms simultaneously and allowed to cure. Once the concrete has hardened, the forms would be removed.

The structure would be built into a 23% slope through the site. The structure is expected to pass all flows and has been designed to best accommodate passage of all lifestages of steelhead. From October to late April, the creek is expected to be concentrated to flowing into the boxes (it would pass through a weir into the first box at the top of the structure). In summer, the ladder would be essentially dry. Unlike a large-scale hydroelectric dam that always have (1) a functioning reservoir behind it; (2) consistent flow rates; (3) consistent velocities and (4) attraction flows, a fish ladder on York Creek cannot guarantee any of these factors. Flow rates are expected to change into and through the ladder depending on the time of year and thus the flow rate of York Creek.

The upstream and downstream portions of the creek from the fish ladder would have the same dimensions and design features as the full dam removal and notch alternatives. The profile upstream of the fish ladder would be 3% instead of 5%. As such, velocities approaching the ladder are expected to be slightly reduced due to the more gradual slope. Routine maintenance for this structure would be required to ensure fish passage.

4.5.2.3 Maintenance of the Fish Ladder

Fish ladders tend to accumulate debris and sediment and require significant, regular maintenance in order to keep them operable for fish passage. Based on maintenance records from the city of St. Helena, approximately 16,000 cubic yards of sediment was transported by York Creek and deposited behind the dam since 1992. This averages to approximately 1,300 cubic yards per year. Much of this material includes cobble, boulders, and woody debris that could potentially clog the fish ladder and would need to be removed prior to high flows as well as during and after each storm event.

Currently, there is a fish ladder located on Sulphur Springs Creek, a neighboring creek to York Creek. According to a memorandum from Lt. Don Richardson of the California Department of Fish and Game, there have been several maintenance issues with this fish ladder. The Sulphur Spring Creek consistently requires maintenance. Each year it plugs with sticks, leaves, rocks, and other in-stream items. It must be unplugged after every significant storm and the degree of blockage seems to vary with the size of the storm and timing (early storms cause more blockages). Some rocks are pounded in by the hydraulic action of water to the degree that they can only be removed with the use of an iron digging bar. In some cases the rocks are simply left in place which further reduces the effectiveness. This maintenance currently causes a drain on personnel and fish passage is blocked until someone clears the blockage after a storm event (DFG, 2005).

According to a consensus met during a meeting with the DFG, Corps, and the NRCS in April 2006, minimal maintenance for a fish ladder on York Creek would likely include the following: (1) an annual pre-storm season clearing of the fish ladders and weir pools. This could require several personnel, the use of picks and shovels, as well as a backhoe and dump truck for fallen trees and/or large boulders. (2) during the storm season, weekly checks and/or clearing of debris and sediment from the fish ladder. (3) following each storm, the ladder should also be cleared of debris and sediment. Due to the amount and size of the sediment particles in the watershed, this could include several personnel, use of picks and shovels and, potentially, the use of a backhoe and dump truck for large trees and/or boulders.

4.5.2.4 Fish Passage

In general, fish ladders are known to provide aquatic passage for a narrow selection of species and age cohort of that particular species. They are designed for anadromous aquatic species and tend to not be a successful tool for the migration of mobile populations of fish and aquatic species.

For this project alternative, all available criteria pertaining to velocities, jump heights, etc., has been incorporated into the fish ladder design. The boxes within the ladder have been designed such that jump height from each pool (box) does not exceed 12 inches.

Unlike a large-scale hydroelectric dam that always has a functioning reservoir providing consistent flow rates, consistent velocities and the possibility for attraction flows, York Creek reservoir has essentially no capacity and is subject to seasonal variation. Flow rates through the dam would depend on the natural flow rate of York Creek. From October to late April, the creek is expected to be concentrated to flowing into the boxes (it would pass through a weir into the first box at the top of the structure). In summer, the ladder would be essentially dry. Since water flow in York Creek tends to vary seasonally, it may significantly affect the operability of a fish ladder such that it would pass fish only during the rainy season (approximately December through April) or possibly large storm events.

4.5.2.5 Accumulated Sediment Removal

As seen in Table 4.6, the estimated amount of accumulated sediment to be removed from behind the dam and fish ladder would be 10,372 cubic yards, or approximately 37% of the total sediment. For more information on the construction aspects of sediment removal, please refer to the information for Alternative 1 or to the information provide in Section 4.0 for the alternative.

4.5.2.6 Channel Restoration

The channel restoration for Alternative 3 would be slightly different than for the previously described alternatives in that the naturally restored channel would start at the top of the dam notch and fish ladder and extend upstream though the sediment basin. The constructed channel would not be built within the natural channel bed. Instead, the sediment behind the dam would be stabilized in order for a more natural creek to feed into the top of the fish ladder. Specifically, the channel would be constructed 10-12 feet above the original channel bed.

4.5.2.7 Revegetation

Revegetation for Alternative 3 is generally similar to the revegetation described for the other action alternatives. However, specific design differences result in a slightly varied revegetation plan for this alternative.

The fish ladder would be a concrete structure built over a lowered dam. It would connect York Creek above the dam with York Creek below the dam. Through the sediment basin, a channel, similar to the channels for the other action alternatives would be constructed within the remaining sediment basin. Bank Zone vegetation would be used on the channel slopes and the remaining sediment would be planted as a Terrace Zone, as done for Alternative 1. As Alternative 3 requires the removal of some sediment, the slopes created by sediment removal would be planted with the trees and shrubs mentioned for the Riparian Zone in Alternative 1. Specifically, Alternative 3 would have 0.4 acres of Bank Zone, 0.9 acres of Terrace Zone and 0.6 acres of Riparian Zone. This totals 1.9 acres of restored habitat acreage.

4.6 EVALUATION OF ALTERNATIVE PLANS

The evaluation of the alternatives allows assessment and appraisal of the effects of the with project conditions of each alternative, and comparison to the future without project conditions. The criteria evaluated in this section have been determined to be the most important to the evaluation of the alternatives. The criteria are separated into four primary considerations: (1) sediment transport including the threat for an accidental accumulated sediment release, downstream riverine deposition, and downstream flooding; (2) slope stability; and (3) environmental resources, including vegetation resources, fisheries and aquatic resources, wildlife resources, cultural resources and aesthetics.

4.6.1 SEDIMENT TRANSPORT

4.6.1.1 Accumulated Sediment Deposition and Accidental Detrimental Downstream Releases

No Action Alternative

If the dam is not removed, most of the sediment carried by York Creek upstream of the dam would likely continue to accumulate around the drain pipe in the reservoir area, much as it has done in the past. Additionally, according to the City's engineers, the 2005-2006 storm season resulted in the expected sedimentation within the reservoir as well as additional sedimentation above the project site in York Creek channel. It is therefore likely that sedimentation would continue in the reservoir as well as upstream of the reservoir in York Creek.

As mentioned previously, on July 28, 1992, during routine maintenance of the reservoir outlet, there was an accidental sediment discharge downstream of the dam. This significant release resulted in a silt discharge "within the stream bed from the face of the dam to a point where the Napa River joins the stream" (DFG, July, 1992). The total distance of impact was approximately 2.5 to 3 miles long. The depth of the silt deposits varied from heavy deposits (up to 18 inches) just below the dam and continuing downstream for about 0.5 miles, gradually thinning until only a light covering of fine silt was deposited a the confluence with the Napa river (DFG, July 1992; DFG Aug 1992).

No action will likely result in a future sediment accumulation in the sediment basin and upstream of the project area. This sediment could lead to a future downstream catastrophic sediment release. It is also possible, like with all historical dams, that this 100-year old dam could fail in the future, which could cause catastrophic sediment releases. This latter possibility has not been further evaluated.

Figure 4.2. Sediment Accumulation. Much from 2005-2006 Storm Season

Alternatives 1 and 2B:

Alternatives 1 and 2B would remove 95-100% of the accumulated sediment behind the dam. In addition, these alternatives provide for a natural hydrologic and sediment transport through the dam site. Unlike the existing condition, where the dam acts as a sediment trap, the stream design for Alternatives 1 and 2B is expected to transport all sediment downstream. Therefore, these alternatives eliminate the threat of a detrimental downstream sediment release.

There are two possible sediment deposition areas on the project site within the channel and these areas may fill in over time and eventually match the 5% profile in the rest of the project area (the slopes in these areas is less than 1%). This is not expected to increase the risk for sudden sediment releases downstream.

Alternative 3:

Alternative 3 would provide for the removal of 37% of the accumulated sediment and the remaining sediment would be covered with a naturally restored creek or restored with native vegetation. The fish ladder would be made entirely of concrete to avoid sediment contributions from the sides of the dam. The only source of sediment is expected to come from upstream sources and are expected to flow through the ladder much as they would through the full removal and notch alternatives.

The profile of the fish ladder would be 3% instead of 5% for other action alternatives. As such, velocities approaching the ladder are expected to be slightly reduced due to the more gradual slope. This decrease in velocity through the project site could lead to future sediment deposition upstream of the dam. Deposition is expected to reach equilibrium and is not expected to cause detrimental sediment releases downstream.

The ladder's box weirs would trap some of the downstream flowing sediment and debris and would require routine maintenance in order to keep it unplugged and functional for fish passage. These costs have been incorporated into the operations and maintenance costs for this alternative and is described in more detail in section 4.6.3.2.

4.6.1.2 Downstream Sedimentation and Flooding

No Action Alternative

The dam acts as a barrier for much of the sediment that is transported from higher reaches of the watershed. Since its construction, it has captured approximately 1,000-10,000 cubic yards of sediment, annually. The No Action Alternative will likely result in an continued blockages for sediment transport and it is expected that this sediment will continue to accumulate behind the dam.

The reservoir does not provide flood protection downstream. The current reservoir provides a very minor capacity for storage. This storage produces a minor delay for downstream flows in small storm events. Once the standpipe is overwhelmed and/or plugged, the reservoir fills until the water level reaches the spillway. At this point, the flows into the reservoir are the same as the flows out of the reservoir; there is no longer a downstream flow difference.

Although the dam is over 100-years old, there has not been a dam-failure investigation done at this project site. If the dam is left in place, a future unforeseen dam failure could cause flood damages downstream.

Alternatives 1 and 2B

Sediment deposition on alluvial fans (valley bottoms) is a natural process and York Creek velocities decrease towards its confluence with the Napa River. Alternatives 1 and 2B would remove or modify the dam that currently blocks natural sediment transport to downstream reaches of York Creek and allow for natural sediment transport thought the project site.

The removal or Upper York Creek dam would allow sediment to be naturally transported downstream to the Napa Valley reach of York Creek. The majority of the sediment will be transported to the Napa River. However, significant percentages (10-20%) of the sediment could be deposited on the bottom of York Creek in the Napa Valley Reach.

The Corps is aware that additional sediment on the channel bottom will decrease channel capacity. This reduction in channel capacity is currently not expected to increase flood duration or flood depth when compared to the existing condition. A more thorough analysis of floodplain depths and flood duration for existing conditions and project conditions will be completed for final design. Modifications to project design and operations and maintenance will be made to minimize any impact.

4.6.2 SLOPE STABILITY

The existing condition could be impacted by future construction when the Selected Alternative is implemented. The highly erosive hillside could experience further landslide if nothing is done to stabilize that area. With the project in place, the possibility of landslide would be lessened as measures to address this unstable ground are implemented.

Geotechnical analysis was done to evaluate the slope stability concerns associated with each of the project alternatives. The geotechnical evaluation was also done to differentiate the alternatives in terms of ground response to excavation and stabilization measures.

For more information, please refer to Appendix C: Geotechnical Engineering.

No Action Alternative

The future without project conditions for topography, geology, and soils are expected to remain relatively unchanged for the foreseeable future. It is believed that the dam provides limited lateral support to the spillway and Spring Mountain Road, which in turn tends to minimize ground movement in the area. However, the build up of trapped sediments upstream of the dam could cause increased lateral earth pressures to the upstream face of the dam that may result to instability of the downstream slope, overtopping of the dam and accidental releases of sediments during high storm events.

Alternative 1

Geotechnical analysis has determined that Alternative 1 requires the highest level of reinforcement measures for the long term structural stability. Results from the geotechnical modeling of lateral deformation indicate excessive deformation on the order of at least 29 inches. This magnitude of deformation could trigger the instability of the excavated slope and the area east of the dam. While this deformation seems excessive it was based on a conservative assumption of design strengths that took into account unknown factors such the presence of sheared zone that are not readily apparent from laboratory testing of intact samples.

Current analysis has shown that Alternative 1 would require 3 rows of 11 reinforcing screw anchor nails (geotechnical slope stability tools) placed through the dam site. These screw anchor nails would be installed 50 to 100 feet into the ground based on their starting position. The actual number of rows of anchors will be determined upon completion of the final investigation and design

Alternative 2B

Alternative 2B is the preferred geotechnical solution for reducing or removing barriers to fish passage and at the same time for maintaining a stable road. Under this alternative the spillway would remain in place and backfilled to provide continued support for the existing road. The actual size of the notch would be based on further geotechnical analysis that would be done during the Design and Implementation Phase for construction.

Current analysis has shown that Alternative 2 would require 2 rows of 11 reinforcing screw anchor nails (geotechnical slope stability tools) placed through the dam site. These screw anchor nails would be installed 50 to 100 feet into the ground based on their starting position. The actual number of rows of anchors will be determined upon completion of the final investigation and design. A monitoring program consisting of geotechnical data from readings of piezometers and inclinometers must be incorporated in the design process to quantify the actual ground movement and stability at the site.

Alternative 3

The concrete fish ladder would be built over a lowered Upper York Creek Dam. It is not expected that this alternative would change the level of stability from the No Action alternative. Therefore no geotechnical modeling was done for this alternative.

4.6.3 ENVIRONMENTAL RESOURCES

4.6.3 1 Vegetation Resources

No Action Alternative

The project site comprises an area of approximately 0.05 acre of riparian habitat, including both banks of the stream. Historically, the project site had riparian habitat along the stream corridor and upland savanna. That habitat has been degraded by construction of the dam, operational errors and neglect, contributing to a large influx of sediment, which has had negative impacts on project site habitat and water quality. Continued disturbance of the sediment inhibits woody native vegetation and favors weedy exotic vegetation. Lack of tree canopy shade increases the temperature of the stream. There are approximately 22 large trees on the project site. Without project conditions, these trees would remain in place.

Without the project, conditions are expected to remain the same.

Alternative 1

Alternative 1 would restore 0.4 acres of Bank Zone, 0.6 acres of Terrace Zone and 1.2 acres of Riparian Zone. This would total 2.2 acres of habitat acreage.

The primary difference in the revegetation plan for Alternative 1 is that it allows for a floodplain terrace that would be planted with native vegetation while in Alternatives 2B and 3 do not allow for a terrace.

Alternative 1 would require the removal of approximately 22 large trees. More specifically, approximately 9 trees measuring 20 diameters at breast height (dbh), 8 trees measuring 30 dbh or less, and 5 measuring greater than 30 dbh would need to be removed. The largest tree to be removed is 78dbh that will need to be removed.

For all alternatives, approximately 475 medium and large tree species will be planted as specified in the Replanting Plan. Specifically, 23 maple, 15 box elder, 15 Oregon ash, 26 coast redwood, 152 tanbark oak, 36 douglas fir, 23 valley oak, 21 California bay laurel, 21 madrone and 144 coast live oak would be planted.

Alternative 2B

Revegetation for Alternative 2B is similar to the description for Alternative 1. Specifically, Alternative 2B would have 0.4 acres of Bank Zone, 0.5 acres of Terrace Zone and 1.1 acres of Riparian Zone. This totals 2.0 acres of restored habitat acreage.

Alternative 2B would require the removal of approximately 20 large trees. More specifically, approximately 8 trees measuring 20dbh, 7 trees measuring 30 dbh or less, and 5 measuring greater than 30 dbh would need to be removed. The largest tree to be removed is 78dbh that will need to be removed.

For all alternatives, approximately 475 medium and large tree species will be planted as specified in the Replanting Plan. Specifically, 23 maple, 15 box elder, 15 Oregon ash, 26 coast redwood, 152 tanbark oak, 36 douglas fir, 23 valley oak, 21 California bay laurel, 21 madrone and 144 coast live oak would be planted.

Alternative 3

Revegetation for Alternative 3 is generally similar to the revegetation described for the other action alternatives. However, specific design differences result in slight variations.

The fish ladder would be a concrete structure built over a lowered dam. It would connect York Creek above the dam with York Creek below the dam. Through the sediment basin, a channel, similar to the channels for the other action alternatives would be constructed within the remaining sediment basin. Bank Zone vegetation would be used on the channel slopes and the remaining sediment would be planted as a Terrace Zone, as done for Alternative 1. As Alternative 3 requires the removal of some sediment, the slopes created by sediment removal would be planted with the trees and shrubs mentioned for the Riparian Zone in Alternative 1. Specifically, Alternative 3 would have 0.4 acres of Bank Zone, 0.9 acres of Terrace Zone and 0.6 acres of Riparian Zone. This totals 1.9 acres of restored habitat acreage.

Alternative 3 would require the removal of approximately 21 large trees. More specifically, approximately 8 trees measuring 20dbh, 8 trees measuring 30 dbh or less, and 5 measuring greater than 30 dbh would need to be removed. The largest tree to be removed is 78 dbh that will need to be removed.

For all alternatives, approximately 475 medium and large tree species will be planted as specified in the Replanting Plan. Specifically, 23 maple, 15 box elder, 15 Oregon ash, 26 coast redwood, 152 tanbark oak, 36 douglas fir, 23 valley oak, 21 California bay laurel, 21 madrone and 144 coast live oak would be planted.

4.6.3.2 Fisheries and Aquatic Wildlife

In 2005, the NCRCD conducted a systematic habitat assessment of York Creek. The report concludes that the upper reach of York Creek offers excellent rearing and spawning habitat for steelhead, and that measures to allow access would greatly benefit the overall steelhead population. Nearly all potential steelhead spawning areas were considered suitable, and temperature monitoring indicates suitable conditions for steelhead.

No Action Alternative

The existing dam and reservoir blocks fish passage to spawning habitat for the federally listed CCC steelhead. The dam will continue to act as a barrier to sediment transport, sediment will continue to accumulate, and the threat of downstream sediment releases and fish kills will persist. Additionally, the presence of the dam and sediment basin creates an unnatural aquatic and riparian dispersal and migration barrier to native species.

Alternative 1

Alternative 1 includes the complete removal of the dam and looking upstream, includes the removal of the right wall of the spillway. Alternative 1 removes the barrier to aquatic and fisheries dispersal, allowing separate populations to move more readily upstream and downstream.

The removal of the dam and the construction of an engineered channel would result in three specific sources of habitat benefit to steelhead and other aquatic wildlife including: (1) restored aquatic habitat through the project site; (2) access to approximately 2 miles of spawning and rearing habitat above the project site, (3) elimination of the threat of downstream habitat destruction via uncontrolled sediment releases, and (4) provides aquatic habitat connectivity for fish and aquatic wildlife species populations through the project site.

Table 4.7.shows the amount of aquatic habitat that is currently available upstream of the project area, but isolated from steelhead populations by the dam. It also shows the amount of aquatic habitat that would be engineered through the project site. The sum of these values is “Total Aquatic Habitat” and includes the total aquatic habitat from the base of the dam, through the project site and to the uppermost reach of steelhead habitat on York Creek. Alternative 1and 2B would provide for 64,440 square feet (1.2 acres) or spawning and rearing habitat for steelhead.

Table 4.7. Aquatic Habitat Types.

	Existing Aquatic Habitat Upstream of Project Site (sq ft)	Alt 1 and 2B Project Site Future Aquatic Habitat (sq ft)	Total Aquatic Habitat (sq ft)	Total Aquatic Habitat (acres)
Pool Habitat	11,053	2,100	13,153	0.30
Flatwater Habitat	13,016	1,281	14,297	0.33
Riffle Habitat	34,705	2,289	36,994	0.58
TOTAL HABITAT	**58,774**	**5,670**	**64,444**	**1.21**

Table 4.8 shows the total length of stream that is currently available upstream of the project area, but currently isolated from steelhead populations by the dam. It also shows creek length that would be engineered through the project site. The total length of aquatic habitat would be from the base of the dam to the uppermost reach of steelhead habitat on York Creek. Because the project area below the dam is already reachable by steelhead populations, it has not been included in the below figures.

Table 4.8. Length of Aquatic Habitat.

Length of Reconnected Aquatic Habitat (ft)	Length of Restored Project Area Habitat (ft)	Total Length of Aquatic Habitat (ft)	Total Length of Aquatic Habitat (Miles)
8,030	825	8855	1.7

Alternative 1 is different from Alternative 2B in that it provides for a total dam removal width of 53 feet, including a 30 foot wide and 50 foot long floodplain terrace through the dam site. Although floodplain terraces are not common in the upper portions of this watershed, the historical presence of the reservoir has resulted in the widening of an otherwise narrow riparian corridor. Alternative 1 uses this reservoir area as an opportunity to provide additional riparian habitat to upland wildlife.

The floodplain terrace would be planted with native vegetation. The presence of this vegetation is expected to provide for a future riparian cover through the dam site and could provide future shading and habitat cover for steelhead.

Alternative 2B

Alternative 2B provides the same benefits to aquatic and fisheries resources as Alternative 1. The primary difference between Alternative 2B and Alternative 1 is that it does not provide for a floodplain terrace or riparian planting area through the dam site. This quantifies to 1,150 square feet less of restored riparian habitat and shading and 0.1 acres less of upland riparian habitat than Alternative 1.

Alternative 3

A fish ladder ideally maintained and cleared throughout the storm season and had that would have adequate flows during the steelhead migratory windows would be expected to provide for similar upstream steelhead passage as Alternatives 1 and 2B. However, as previously mentioned, it is unlikely that a fish ladder on York Creek would function in this way. The levels of uncertainty are higher, and the likelihood of functional success is lower.

Although there is no scientific literature that specifically compares the effectiveness of steelhead passage through a fish ladder versus a naturally engineered aquatic passage, there is a general acceptance by fish experts that a naturally restored creek would provide for more effective fish passage. A naturally engineered aquatic passage would more closely resemble a natural state when compared to a fish ladder and would be expected to provide aquatic passage for all species and lifestages. A fish ladder would not. Fish ladders are designed for specific species of migratory fish and tend to not be a successful tool for the migration and dispersal of other fish and aquatic species.

Additionally, unlike a large-scale hydroelectric dam that has a functioning reservoir behind it and a consistent flow rate, flows cannot be guaranteed or implemented at this site. Flow rates are expected to change through the ladder depending on the time of year and would be inconsistent. Flow fluctuation and natural sediment yields tend to accumulate debris and sediment and require significant, regular maintenance in order to keep them operable for fish passage. Figure 4.3 shows the sediment and debris accumulation from the 2005-2006 storm season.

Figure 4.3. Upper Reservoir during 2005-2006 Storm Season. Photo taken Spring 2006.

In order to quantify the difference in effectiveness between a fish ladder and a natural creek, a meeting was coordinated with fish experts from the DFG and the NCRCD and the San Francisco district's resident fisheries biologist, Peter LaCivita, in April 2006. Outputs from this meeting include a general understanding of the maintenance requirements of a fish ladder and estimated effectiveness percentages for steelhead passage through the fish ladder (Plan Form: Appendix L). As would be shown below, effectiveness of passage has been separated into adult upstream migration, smolt downstream migration, and local juvenile dispersion.

According to the consensus met during the April 2006 fisheries meeting, minimal maintenance for a fish ladder on York Creek would likely include the following: (1) an annual pre-storm season clearing of the fish ladders and weir pools. This could require several personnel, the use of picks and shovels, as well as a backhoe and dump truck for fallen trees and/or large boulders. (2) during the storm season, weekly checks and/or clearing of debris and sediment from the fish ladder. (3) following each storm, the ladder should also be cleared of debris and sediment. Due to the amount and size of the sediment particles in the watershed, this could include several personnel, use of picks and shovels and, potentially, the use of a backhoe and dump truck for large trees and/or boulders. For more specific information about the meeting, please refer to the Plan Formulation Appendix.

Assuming that the above maintenance is in place for the 50-year planning analysis period of this project, the meeting team then discussed the effectiveness of the fish ladder in comparison to an engineered channel. By assigning estimated effectiveness percentages to migration through the fish ladder, it would then be possible to calculate an estimate difference between Alternative 3 and the other action alternatives.

Please note that estimates are based on the best available information and knowledge of steelhead migration. Because there is a very high level of uncertainty with these estimates, the team only felt confident assigning a broad range percentage to the possible effectiveness.

For comparison purposes, it is estimated that a naturally engineered stream through the project site would provide 100% effectiveness for migrating steelhead. This includes upstream migrating adult steelhead, downstream migrating smolts, and also local migration and dispersal in York Creek.

Fish ladder blockages are expected to lower the effectiveness of the fish ladder for fish passage. Although exact estimates are unknown, it is expected that during each storm, the fish ladder would become impassible until the ladder is cleared.

NCRCD operates a stream gaging station on York Creek at HWY29, for the City of St. Helena. The gage was installed in Dec 2005, and the data indicate that there were 13 "large" spikes in the stage record during the past rainy season. NCRCD preliminary estimates show that each of these 13 spikes could produce a lot of debris. Therefore, during this past rainy season, some or all of these 13 streamflow events could have clogged a fish ladder. Since 2005-2006 was an active rain year, it is presumed that in an average year, the fish ladder might become clogged up to 10 times in an average year. If only the largest flows produce enough debris, then estimates would expect 6-7 clogs this past year, and 4-5 in an average year. For the purposes of this report, 4-7 clogs in any given year would be used to evaluate fish passage, which is believed to be a conservative estimate.

The migration window for steelhead upstream migration is approximately 150 days. Of these 150 days, the fish ladder could potential clog 4-7 times in any given year. This could result in a loss of 2-7 days with each clog event depending on how long it takes to clear the fish ladder. Using these estimates, the fish ladder could block upstream migration 8-49 days each year, or 5-33% of all migration days could be lost. Therefore, these preliminary blockage estimates indicate that a fish ladder would provide for 65-95% effectiveness when compared to notching or removing the dam.

Table 4.9. Steelhead Migration Effectiveness through the Fish Ladder.**

	Migration Windows	Natural Migration Days	Migration Effectiveness (%)
Adult Upstream Migration*	December-April	150	65-95%

Smolt Downstream Migration**	January-May	150	80-90%
Local Juvenile Downstream Dispersal**	Year Round	365	100%

* Values calculated based on preliminary hydrological estimates by NCRCD
** Values estimated during April 2006 Fisheries Meeting (See appendix L: Plan Form)

The estimate for Adult Upstream Migration will also be used in Section 4.8 as a comparison tool for benefit quantification.

4.6.3.3 Riparian Wildlife

DWR's Environmental Services Office has carried out biological and cultural resource surveys in the vicinity of Upper York Creek Dam and the masonry diversion structure. These surveys included, but were not limited to, protocol surveys for red-legged frogs, California freshwater shrimp, northern spotted owls, and sensitive plant species. DWR then prepared an Initial Study, which provides a thorough consideration of special-status species.

The forest in the vicinity of the project site provides habitat for numerous wildlife species typical of the California Coast Ranges. Common mammals include black-tailed deer, coyote, bobcat, raccoon, and skunks. Birds include a variety of raptors and songbirds. During site visits to the Lower Diversion Structure Restoration Project, which, is located downstream of Upper York Creek Dam, DWR biologists observed red-tailed hawks, Cooper's hawks, turkey vultures, and juvenile great horned owls, among other bird species, in the vicinity of the Upper Reservoir.

The relatively cool, moist forest surrounding Upper York Creek Dam and Upper Reservoir also provides suitable habitat for banana slugs, observed during several site visits, and Pacific giant salamanders, indicated by the observation of one dead adult in York Creek, upstream from Upper Reservoir, on November 19, 2001. The Upper Reservoir and a scour hole at the base of the Upper York Creek Dam spillway contain numerous non-native bullfrogs. The signal crayfish is another non-native predator observed throughout York Creek and in the Upper Reservoir (ENTRIX 2002).

Riparian wildlife can currently migrate over and/or around the dam so the dam does not block land-based dispersal.

No Action Alternative

Without-project conditions for the Upper York Creek Dam are expected to remain relatively unchanged for the foreseeable future.

Alternative 1

Alternative 1 would provide approximately 2 acres of additional riparian habitat to local wildlife. Non-native vegetation would be removed throughout the entire project site and would be seeded and planted with native vegetation. This would provide additional riparian habitat to local wildlife.

Through the dam site, 0.1 acre (of the total 2 acres) planted with native vegetation would provide for the most natural riparian habitat through the dam site. Alternative 1 would not require vegetated riprap for erosion protection.

Alternative 2B

Wildlife resources are expected to be similar to those described for Alternative 1. The primary difference is that Alternative 2B does not provide for a floodplain terrace through the dam site and instead the right bank would be lined with vegetated riprap for erosion protection along the 50-linear feet of restored stream.

Alternative 3

The fish ladder is a concrete structure through the dam site. In this area, there are no benefits to land-based wildlife. Upstream of the dam site and in the sediment basin, the restored creek and adjacent habitat would be constructed similar to the description for the other action alternatives.

4.6.3.4 Cultural Resources

The San Francisco District consulted with the State Historic Preservation Officer in accordance with regulations at 36 CFR Part 800 implementing Section 106 (National Historic Preservation Act). This resulted in a consensus-based determination that the York Creek Upper Reservoir Dam and Lower Diversion Structure qualified as a historic property, citing architectural and engineering features that exhibit a local level of significance under the theme of community planning and development..

All Action Alternatives would have an adverse effect on the historic property. Typically, negative impacts to historic or archaeological properties are caused by new development that either disturbs or destroys the location of the property. The modification or removal of the Dam for purposes of restoring fish passage is different in that the impact to the historic property actually derives from a proposal that benefits the environment. Thus the proposed undertaking cannot avoid affecting the integrity of the historic property's design, feeling, and association.

The Corps, as the Federal agency responsible for meeting the Section 106 requirements, would continue consultation with the State Historic Preservation Officer (SHPO) to discuss the adverse impact and to offer a treatment plan (i.e. mitigation documentation) to resolve the adverse effects. The appropriate scope of the documentation (considering the nature and significance of the property) would be based upon results of SHPO consultation and views expressed by interested parties. Such documentation is often the last means of preserving the physical information about a historic property, so that future researchers would have access to valuable information that otherwise would have been lost.

No Action Alternative

Without-project conditions for the Upper Reservoir Dam are expected to remain relatively unchanged for the foreseeable future.

Alternative 1

Action Alternative 1 would produce the greatest adverse affect to the historic property by removing the entire dam, which would preclude the property from conveying its historical significance.

Consultation and a mitigation documentation would be used to resolve the adverse effects. The appropriate scope of the documentation will consider the nature and significance of the property and be based upon results of SHPO consultation and views expressed by interested parties.

Alternative 2B and 3

Action Alternative 2B would produce a degree of physical alteration to the historic property that would constitute an adverse effect by removing part of the dam, which would preclude the property from conveying its historical significance.

Consultation, mitigation, and documentation would be the same as that noted in Alternative 1.

4.6.3.5 Visual and Aesthetics

No Action Alternative

Without-project conditions for the Upper York Creek Dam are expected to remain relatively unchanged for the foreseeable future.

Alternative 1 and 2B

Alternatives 1 and 2B are expected to improve the overall aesthetics of the project site. Restoration would lead to the development of more natural riverine and riparian habitat.

More specifically, Alternative 1 would create the largest construction footprint but would also provide the greatest opportunity for riparian planting. Alternative 2B would allow for a slightly smaller opportunity for riparian planting and would require the installation of vegetated riprap for erosion protection. The vegetation would completely cover the riprap and the vegetated riprap would not be seen from the road.

There would be short-term visual impacts during construction of the proposed project due to the presence of construction equipment and the necessary removal of some vegetation at the project site. Specifically, earthmoving operations would be visible from the roadway along approximately 600 feet of Spring Mountain Road. However, this negative visual impact would not be significant, and the long-term impact of the project, after re-vegetation, would be positive because it would result in the project sites blending with the natural appearance of their surroundings.

Aesthetics would be an integral part of project design and would include a major revegetation effort using native plant species that blend with the natural surroundings. Cuts made by construction equipment would not be left with a machined or unnatural appearance and contour grading would blend with the natural topography. Site specific measures for erosion control would be utilized, including erosion control methods that blend with the natural surroundings. The project site would have clearly defined limits, and a row of trees would be left along much of the roadside to minimize the area that is visually impacted.

Alternative 3

The fish ladder alternative would involve excavating a short, V-shaped channel through the dam, about 10-feet deep, 30-to-60-feet wide at the top, 10-feet wide at the bottom, and 120-feet long. This is much less excavation than the other Action Alternatives, but there would still be eight V-notch weirs upstream of the remaining dam to account for the 10 feet of grade drop. Compared to the other alternatives, Alternative 3 would place a large concrete structure in the project site and is considered less aesthetically pleasing than the other alternatives, including the No Action Alternatives.

Given the substantial woody debris and sediment load, a ladder alternative would undoubtedly require an additional, perpetual maintenance cost, would be vulnerable to vandalism, and may require fencing to reduce human risk or vandalism. The reduced grade upstream of the finished ladder would remain more depositional than the other alternatives.

4.7 COMPARISON OF THE ALTERNATIVE PLANS

All of the action alternatives involve varying levels of dam modification, removal of dam material, removal of accumulated sediment material, revegetation of approximately 2 acres, and channel restoration. The final alternatives are differentiated by the portion of dam removed where Alternative 1 provides the greatest portion of dam removal, Alternative 2B provides for the removal of a "notch" through the dam, and Alternative 3 provides for the lowering of the dam and placement of a fish ladder over the remainder of the dam. Table 4.2: Details of Project Alternatives, shows these differences by showing the total dam and sediment material that would be removed.

4.7.1 FISH PASSAGE:

Reestablishment of fish passage upstream of Upper York Creek Dam is also common to all the action alternatives, where Alternatives 1 and 2B provide for a restored natural creek bed and Alternative 3 provides for a fish ladder aquatic passage over the lowered dam. For comparison purposes, it is estimated that alternatives 1 and 2B would provide 100% effectiveness for upstream migrating steelhead whereas Alternative 3 would provide for 65-95% effectiveness.

4.7.2 FUTURE DOWNSTREAM HABITAT DEGRADATION AND FISH KILLS:

From the perspective of accumulated sediment and the future threat of sediment release, all action alternatives provide for sediment removal. Alternatives 1and 2B provide for the removal of 95-100% of sediment and Alternative 3 provides for the removal of 37% of the sediment. The naturally restored creek for alternatives 1 and 2B also provides for the most natural sediment transport system in the future and thus eliminate the threat of an accidental accumulated sediment release.

Alternative 3 reduces the threat of accidental sediment releases but does not eliminate it. Alternative 3 would leave 63% of the total accumulated sediment behind the lowered dam.

4.7.3 HABITAT RESTORATION:

Riverine restoration in York Creek is most natural for Alternatives 1 and 2B. The primary difference between the action alternatives is that Alternatives 1 and 2B would be constructed, as feasible, to flow through the historical channel. Alternative 3 would be constructed from the top of the fish ladder (over the dam) and through the remaining sediment basin. For Alternative 3, the channel would be 10-12 feet above the original channel bed.

From the perspective of habitat restoration, all alternatives follow a single methodology for the revegetation of the project site. The project would provide for the revegetation of approximately 2 acres of disturbed area for all alternatives. The primary difference in the revegetation plan for Alternative 1 is that it allows for a floodplain terrace that would be planted with native vegetation, while Alternative 2B and Alternative 3 do not allow for a terrace. Floodplain terraces are not a natural feature to the upper York Creek watershed. However, the 100-year old reservoir has left an unnaturally wide open area at the project site and there was initial resource agency support for an increased floodplain terrace habitat through the project site. Alternative 1 provides this additional habitat whereas a cut slope with vegetated riprap would be necessary for the right-bank of Alternative 2B. Alternative 3 provides for the least amount of revegetation.

4.7.4 CONNECTIVITY

The removal and/or modification of Upper York Creek Dam will allow for a more natural hydrologic and sediment transport system. Of the 3 remaining alternatives, Alternatives 1 and 2B would provide for the most natural hydrologic and wildlife migration and dispersal corridor. These alternatives would allow fish and wildlife species to migrate and disperse though their historical aquatic and riparian habitat ranges.

4.7.5 COMPLETENESS

Completeness is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects. In general, the alternatives are all complete. Impacts resulting from the actions of dam modification, common to all the action alternatives were evaluated. No further measures are needed to allow for the functioning of the alternatives.

4.7.6 EFFECTIVENESS

Effectiveness is the extent to which an alternative plan alleviates the specified problems, achieves the specified opportunities, and satisfies constraints. Each of the alternatives is effective in addressing the problems and opportunities identified as part of this study, and all make significant contributions to the objectives, while satisfying constraints. The degree of effectiveness, however, varies for the ability of adult steelhead passage success and juvenile outmigrant success. Alternative 3 would provide for lower passage effectiveness when compared to a restored stream through the dam site. In addition, routine maintenance is necessary for this structure to remain effective as they tend to accumulate debris and sediment.

4.7.7 EFFICIENCY

Efficiency is the extent to which an alternative plan is the most cost-effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the Nation's environment. The individual components or measures of an alternative were selected after careful consideration of alternate means, including costs, of accomplishing a similar goal.

4.6.8 ACCEPTABILITY

Acceptability is the workability and viability of the alternative plan with respect to acceptance by state and local entities and the public and compatibility of existing laws, regulations, and public policies. Alternative 3 is the least acceptable alternative to the resource agencies involved with this project. The Corps has received letters from RWQCB, DFG, and NMFS expressing concern with the fish ladder. The major concerns are that the fish ladder alternative does not adequately eliminate the sediment discharge issues and would not be as effective for fish passage. The Corps PDT has worked closely with these agencies and has incorporated their comments into the analysis of Alternative 3.

Below, Tables 4.10 and 4.11 provide a summary of Environmental Quality Impacts, Regional Economic Development (RED), and Other Social Effects (OSE).

Table 4.10. Summary of Environmental Quality Impacts.

Alts	Environmental Quality Impacts									
	Air Quality Impacts	Cultural Resources Impacts	Downstream Sediment Impacts	Noise Impacts	Road Truck Traffic Impacts	Slope Stability Impacts	T&E Species Impacts	Turbidity	Vegetation Resources (acres revegetated)	Water Quality Impacts
No-Action	NA	NA	Low	NA	NA	NA	NA	NA	0	NA
1	Low Impact from Trucks and Large Equipment	Moderate: Structure would be removed.	Low: To be further investigated in Design	Low	Moderate	Low: To be further investigated in Design	Habitat Improved	Low	2.2	Low
2B	Low Impact from Trucks and Large Equipment	Moderate: Structure would be modified	Low: To be further investigated in Design	Low	Moderate	Low: To be further investigated in Design	Habitat Improved	Low	2	Low
3	Low Impact From Trucks And Large Equipment	Low: Historical Structure would be changed	Low: To be further investigated in Design	Low	Moderate	Low: To be further investigated in Design	Habitat Improved	Low	1.9	Low

Table 4.11. Summary of RED and OSE Outputs.

Alternative	Other Impacts		Regional Economic Development (RED)			Other Social Effects (OSE)		
	Constructability Risks	**Hardening structures required**	**Benefit to Regional Industry**	**Aggregate Sale**	**Regional Construction Industry**	**Flood Risk**	**Aesthetics**	**Recreational Benefits**
No-Action	NA	NA	NA	NA	NA	Low	NA	NA
1	Moderate: Geotechnical Stability measures necessary	NA	NA	NA	Temporary benefit	To be further investigated in Design.	Improved: More natural	NA
2B	Low	Vegetated Riprap required for erosion protection	NA	NA	Temporary benefit	To be further investigated in Design.	Improved: More natural	NA
3	Moderate	Cement Structure	NA	NA	Temporary benefit	Low	Lower: Concrete structure in stream path.	NA

4.8 ALTERNATIVE BENEFITS

The benefits associated with the alternatives have been calculated by combining current steelhead habitat availability with current trout population estimates. Together, this information allows for the calculation of the steelhead carrying capacity for Upper York Creek upstream of the dam. Below is a short explanation of how this estimate was developed. Details can be found in Appendix L: Plan Formulation.

For the purposes of this project, NCRCD assisted the Corps by combining habitat data for York Creek with current rainbow trout[2] density data to produce an estimated steelhead carrying capacity[3]. This produced an estimate for the number of steelhead that York Creek could support from the base of the dam, through the project site, and to the uppermost reach of York Creek. Estimates are based on rainbow trout populations in September 2005. Steelhead populations in September would primarily include steelhead that are 4-6 months old.

Habitat survey data collected in 2003 by NCRCD were compiled for the reaches above the Upper York Creek Dam to the end of potential steelhead habitat at a bedrock falls (NCRCD, 2005). These data were used to calculate usable habitat estimates for juvenile steelhead rearing. Steelhead densities calculated from electrofishing efforts by Stillwater Sciences (2005) were then assigned to each habitat category to estimate potential carrying capacity. Documentation from NCRCD can be found in Appendix L: Plan Formulation

The NCRCD habitat survey data was introduced in 4.6.3.2: Fisheries and Aquatic Wildlife and would be summarized for the purposes of this section. Below, Table 4.12 shows the total aquatic habitat that is available upstream of the dam, but currently isolated from steelhead migration and spawning by the dam.

Table 4.12. Total Aquatic Habitat Types.

	Total Aquatic Habitat (sq ft)	**Total Aquatic Habitat (acres)**
Pool Habitat	13,153	0.30
Flatwater Habitat	14,297	0.33
Riffle Habitat	36,994	0.58
TOTAL HABITAT	**64,444**	**1.21**

[2] **Rainbow trout**: Rainbow trout and steelhead are the same species of fish; the two names reflect two distinct life history patterns. The name rainbow trout is used for the non-anadromous life history. Rainbow trout do not leave the stream to go to the ocean. They spend their entire life in the stream. Anadromous forms of the trout can convert to resident populations when drought events or damming of rivers blocks their access to the ocean. Conversely, resident trout populations can become anadromous if ocean access becomes available (NCRCD, 2006). There is a rainbow trout population above Upper York Creek Dam.

[3] **Carrying capacity**: is defined as the "maximum population size of a species that an area can support without reducing its ability to support the same species in the future".

Table 4.13 shows the total length of stream that is currently available upstream of the project area, but currently isolated from steelhead populations by the dam.

Table 4.13. Total Length of Aquatic Habitat.

	Total Length of Aquatic Habitat (ft)	Total Length of Aquatic Habitat (Miles)
Aquatic Habitat	8855	1.7

Table 4.14 shows the steelhead density estimate that was established with the Stillwater Sciences data. High and low density estimates represent the highest and lowest recorded value respectively. Moderate estimates are the average of the two.

Table 4.14. Steelhead Trout Densities in York Creek above the Project Site.

Steelhead Density (# of steelhead per square foot)			
Aquatic Habitat	**High**	**Moderate***	**Low**
Pool	0.053	0.0375	0.022
Flatwater	0.021	0.015	0.009
Riffle	0.022	0.0165	0.011

*calculated value

Table 4.15 shows the estimated steelhead carrying capacity upstream of Upper York Creek Dam, including the proposed length of restored creek channel in the Upper Reservoir area. The original NCRCD's estimates did not include habitat within the project area; they included only the habitat from above the sediment reservoir to the upper watershed. The below estimates have been adjusted to reflect the habitat that would be created if alternatives 1, 2A[4], 2B, or 3 were constructed. Steelhead densities calculated from the Stillwater Sciences efforts were low density estimates and represent the highest and lowest recorded value respectively. Moderate estimates are the average of the two.

[4] Although Alternative 2A was dropped from further consideration, it will be included in sections 3.15 and 3.16 so that the rationale for removing it from consideration is clear.

Table 4.15. Estimated Steelhead Carrying Capacity for Aquatic Habitat above Upper York Creek Dam.

ESTIMATED CARRYING CAPACITY			
	HIGH	MODERATE*	LOW
POOL	**697**	493	289
FLATWATER	**300**	214	129
RIFFLE	**814**	610	407
TOTAL STANDING CROP	**1,810**	1,320	825
STEELHEAD PER 100 ft.	**23**	16	10

*calculated value

NCRCD estimated that the upstream reaches could annually support between ~825 and ~1,810 juvenile steelhead given current habitat conditions. This does not account for other factors such as temperature, sediment, and predation that all may have an unknown effect on the upstream population. NCRCD, DFG, and the Corps are confident with the high estimates for short term estimation (5-10 years) as electrofishing results were conservative in comparison to density data on other creeks in the Napa River Watershed. This could be caused by several factors, including the presence of the Upper York Creek Dam. Sensitivity analysis for the range of carrying capacity showed is shown in Appendix L: Plan Formulation.

4.8.1 PROJECT BENEFIT QUANTIFICATION

Upstream benefits would be used to determine the number of steelhead that could potentially utilize the habitat upstream of the dam. For Alternatives 1, 2A and 2B, the ecosystem restoration benefits would equal the "High" estimates for the total standing crop of steelhead. This would be approximately 1,800.

Due to the difference in effectiveness described in section 4.6.3.2: Fisheries and Aquatic Wildlife, the fish ladder is expected to produce 65-95% of the total benefits as it's effectiveness is only 65-95% when compared to alternatives 1, 2A, and 2B.

Below, Table 4.16 summarizes the upstream ecosystem restoration benefits for the project alternatives.

Table 4.16. Ecosystem Restoration Benefits

Alternative	Upstream Ecosystem Benefit Units		
	Potential Steelhead Carrying Capacity[5]	Percentage Effectiveness for Steelhead Passage	Total Ecosystem Benefits
No Action	1800	0%	0
1	1800	100%	1800
2A	1800	100%	1800
2B	1800	100%	1800
3	1800	65-95%	1205-1710

4.9 ALTERNATIVE COSTS

The project benefits and costs for each of the alternative are presented Table 4.17.

[5] The "high" carrying capacity estimate was used for the ecosystem benefit quantification based on feedback from DFG, NCRCD, and Peter LaCivita, Corps Fisheries Biologist. Please see section 3.3 Alternative Benefits for more information.

Table 4.17. Benefits and Costs (FY 2006 Price Levels)

Cost Items	Alt 1	Alt 2A	Alt 2B	Alt 3
Benefits				
Ecosystem Benefits	1810	1810	1810	1205-1710
LERRDs (Estimation based on 2005 preliminary estimate; To be updated in July 2006)				
Land Acquisition	$167,000	$167,000	$167,000	$167,000
Federal Administration costs	$93,500	$93,500	$93,500	$93,500
LERRDs Subtotal	**$260,500**	**$260,500**	**$260,500**	**$260,500**
Plans and Implementation Phase				
Geotech	$80,000	$80,000	$80,000	$80,000
Water Resources	$100,000	$100,000	$100,000	$100,000
Environmental Compliance	$50,000	$50,000	$50,000	$50,000
Other	$20,000	$20,000	$20,000	$20,000
P&I Phase Subtotal	**$250,000**	**$250,000**	**$250,000**	**$250,000**
Construction Phase				
Construction	$5,686,238	$4,900,400	$4,884,599	$4,055,384
Engineering During Construction	$150,000	$150,000	$150,000	$150,000
Supervision & Administration	$350,000	$350,000	$350,000	$350,000
Cultural Resources	$30,000	$30,000	$30,000	$30,000
Construction Phase Subtotal (inc. LERRDs and P&I)	*$6,726,738*	*$5,940,900*	*$5,925,099*	*$5,095,884*
Monitoring & Adaptive Management	$233,295	$219,405	$208,266	$211,120
TOTAL FIRST COST	$6,960,033	$6,160,305	$6,133,365	$5,307,004
Total Costs				
TOTAL FIRST COST	$6,960,033	$6,160,305	$6,133,365	$5,307,004
Interest during construction	$447,788	$385,903	$384,659	$319,959
TOTAL GROSS INVESTMENT	$7,407,821	$6,546,208	$6,518,024	$5,626,963
Total Cost of Maintenance (OMRR&R)	$1,037,258	$1,037,258	$1,037,258	$1,936,210
TOTAL COST	$8,445,079	$7,583,466	$7,555,282	$7,563,173
Annual Costs				
Annual Costs of Total Gross Investment	$484,891	$436,779	$435,205	$435,612
Annual Cost of Maintenance (OMRR&R)	$20,745	$20,745	$20,745	$38,724
Total Annual Costs (AAC)	$505,636	$457,524	$455,950	$474,336
Average Annual Cost per Ecosystem Benefit	**$268**	**$241**	**$240**	**$265-$362**

4.10 NATIONAL ECOSYSTEM RESTORATION PLAN

Alternative 2B is the National Ecosystem Restoration Plan as it is the most cost effective plan for the highest level of ecosystem restoration benefits. The Sponsor is supportive of the NER plan.